Abstract

Mars Network for Enabling Low-Cost Missions

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A recent Mars Exploration Program Architecture Definition Study made a strong recommendation for a low-cost *in-situ* communications and navigation satellite network to provide enabling and enhancing support for the international exploration of Mars. This would constitute the first step in building an interplanetary internet and establishing a "virtual presence throughout the solar system" as called for in NASA's Strategic Plan. Funding was provided for conducting the phase A study of this Mars network in FY99.

Implementation of this network is planned to begin with the gradual deployment of a constellation of relatively low-altitude, low-cost MicroSats. This constellation is to be augmented, as needed, with more capable Mars areostationary satellites (MARSats) to support future robotic outposts and ensuing human missions. The MicroSat constellation is based on use of a common micromission bus designed for launch by the Ariane 5 as a secondary payload. Preparations for implementation of the first network MicroSat, including competitive selection of an industry partner for the spacecraft bus, are proceeding toward launch for injection to Mars in the 2003 opportunity. One or two additional MicroSats are to be launched on each succeeding Earth-to-Mars opportunity until the planned steady state constellation of six satellites is achieved. The Mars network will be deployed, maintained and operated as an extension of NASA's Deep Space Network to serve as reliable communications infrastructure available for the support of future Mars missions .

The introduction of this paper discusses the background leading to the network concept and implementation strategy utilizing the common micromission bus and Ariane 5 piggyback launch. The primary focus of the paper is the communication and navigation capabilities the network will make available to enable and enhance low-cost Mars exploration missions. The benefits of the network include:

In-situ UHF relay links allowing much simpler and less expensive user communications systems and requiring greatly reduced mass and power/energy compared with direct-to-Earth links.

Global support of multiple users with very frequent contacts. Complex operations can be supported by numerous round trip communications loops per sol with science / engineering teams on Earth.

Greatly increased data return for small, low-cost missions.

In-situ navigation capability for user position or state determination for elements on or above the surface and assistance in precision landing.

The paper also discusses the protocol and communications design characteristics important for user and network compatibility.